

THE WEATHER AND CIRCULATION OF JULY 1970

Variable Weather Ending in a Period of High Air Pollution Potential in the East, Persistently Warm in the Southwest

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1. WEATHER HIGHLIGHTS

A threat of dangerous concentrations of air pollution developed over several Eastern States in late July when a cold Canadian High gradually transformed into a warm anticyclone. As the atmosphere became more stable and air currents more sluggish, contaminants remained where they formed. Advisories of high pollution potential began on July 28 for an area from the southern Appalachians to southern Pennsylvania and continued for several days as the threatened area slowly diminished in size. By August 1, the state of the circulation had improved so much that advisories were no longer necessary.

Tropical storm Becky went inland at Port St. Joe, Fla., on the morning of July 22, bringing heavy rains and squalls to the Florida Panhandle. Though it had intensified with winds to near-hurricane force in the eastern Gulf of Mexico, the storm remained poorly organized and weakened before it reached shore. From preliminary reports, it appears that destructive winds were limited to two tornadoes that damaged property in Panacea, Fla., and Jefferson County, Ga. Moisture from the storm contributed to widespread rainfall east of the Mississippi River and south of the Great Lakes.

It was the warmest July of record (88.3°F) at Bakersfield, Calif., where average temperatures for each week were above normal, and at Pueblo, Colo. (80.3°F), where daily record maxima were equaled or exceeded on 5 days. No stations reported their coolest July of record, but many reported record daily minima with the strong outbreak of Canadian air after midmonth.

2. MEAN CIRCULATION

Over North America, the 700-mb mean circulation this July closely resembled the normal; but elsewhere in the hemisphere, there were large departures in several systems. Among these, the most notable was the negative anomaly of 90 m in a deep vortex over the Norwegian Sea (figs. 1 and 2). Average heights along the Norwegian coast decreased as much as 180 m from June as this Low replaced a blocking ridge over Scandinavia. Height falls (not shown) of 100 m occurred near the Bering Strait as the blocking High in Siberia retrograded and was partially replaced by the Bering Sea Low. This Low deepened as it moved slowly northward; its central height anomaly in July was -80 m. Windspeeds increased to twice the July

normal between the Bering Sea Low and the Pacific High, which also increased in strength and moved northward. Speedup of the westerlies here was mainly responsible for a rise of the zonal (35°-55° N.) index from 7.0 m sec⁻¹ in June to 8.1 m sec⁻¹ in July.

The principal axis of maximum west winds was north of its usual July path around most of the hemisphere, with average windspeeds more than 15 m sec⁻¹ over parts of the north-central Pacific and northeastern Atlantic (fig. 3). Blocking over Asia led to wide departures from the usual wind pattern there. One branch of the westerlies looped far northward into the Arctic, and another emerged from China.

Easterly winds were much faster than normal south of the strong central Pacific High. This pattern may have led to the development of one tropical depression to storm intensity north of Wake Island on the 21st. Other tropical storms were confined to extreme eastern and western portions of the Pacific.

3. TEMPERATURE

Departures of average temperature from normal were less than 2°F at most stations, as would be expected with height anomalies of small magnitude (fig. 4). Highest temperatures relative to normal were in the Southwestern States where average departures for each week were positive. Other areas where temperatures averaged more than 3°F above normal were northern Minnesota and Maine, both with less than normal precipitation. A hot spell late in the month brought 8 consecutive days of 90°F or more at Concord, N.H., and Hartford, Conn. This was a record occurrence for July at Concord and equaled the all-time record for any month at Hartford. A record high temperature for the month of July, 103°F, was recorded at both Columbia, S.C., and Port Arthur, Tex., during the first week.

The absence of record-breaking low temperatures for the month as a whole is in good agreement with the prevalence of positive height departures (fig. 2) over the United States. However, record daily minima far outnumbered maxima, mostly attributable to an outbreak of Canadian air after midmonth. On the 21st, lows of 44°F at Springfield, Mo., and 47°F at Topeka, Kans., were the lowest recorded for any July; and at Oklahoma City, Okla., record minima occurred on 5 consecutive days beginning on the 20th.

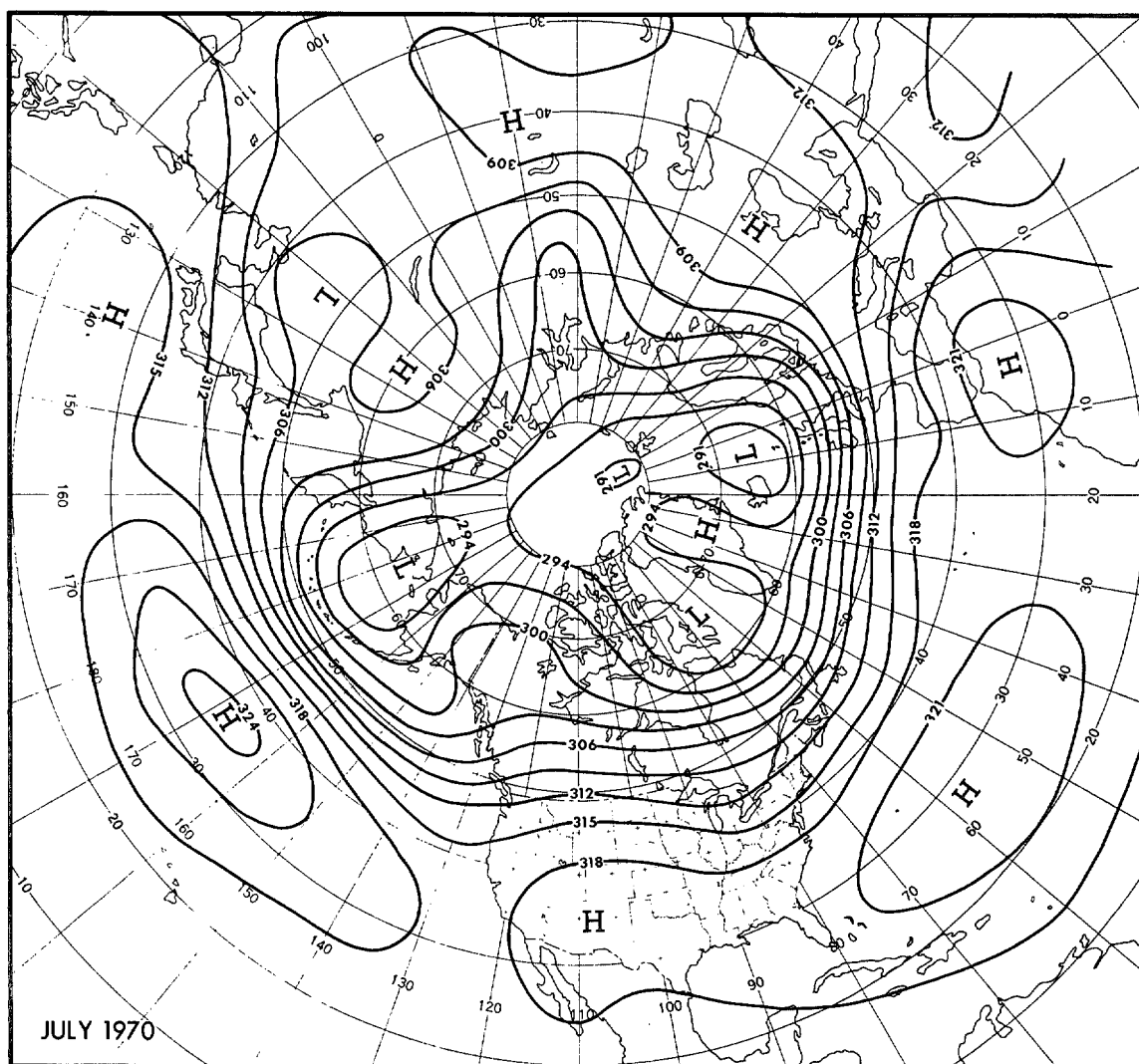


FIGURE 1.—Mean 700-mb contours (decameters) for July 1970.

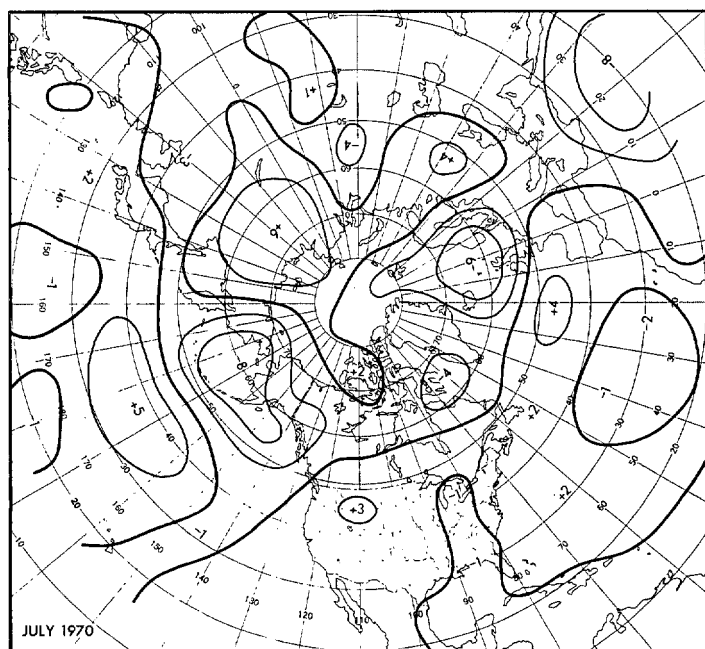


FIGURE 2.—Departure from normal of mean 700-mb height (decameters) for July 1970.

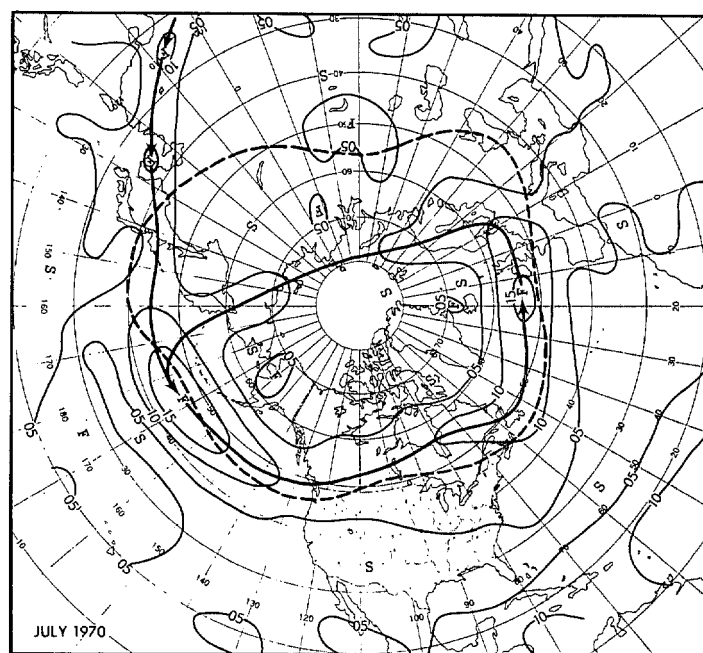


FIGURE 3.—Mean 700-mb isotachs (meters per second) for July 1970. Heavy arrows indicate principal axes of maximum wind-speed, dashed lines the normal.

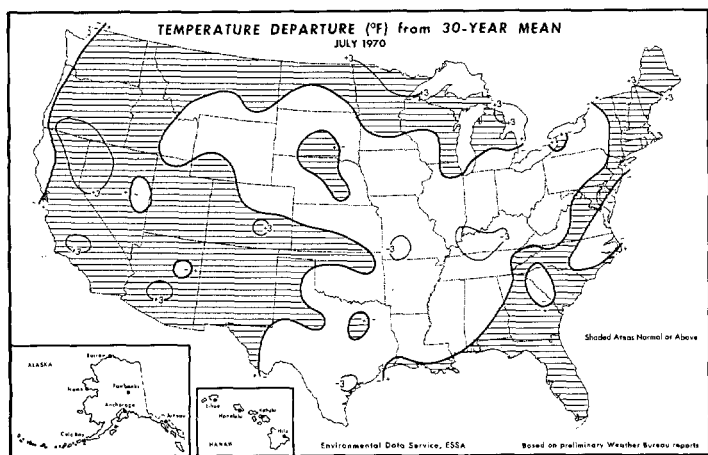


FIGURE 4.—Departure from normal of average surface temperature (°F) for July 1970 (from Environmental Data Service 1970).

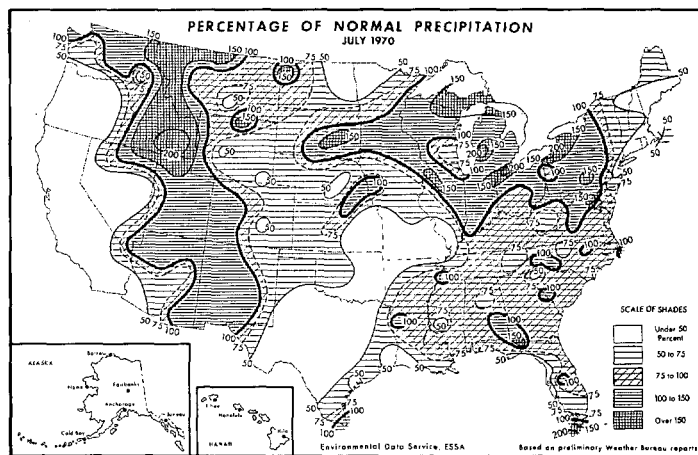


FIGURE 5.—Percentage of normal precipitation for July 1970 (from Environmental Data Service 1970).

4. PRECIPITATION

Rainfall exceeded normal just west of the Continental Divide and in the Great Lakes Region (fig. 5). The latter area appears to be well related to the mean trough and slightly negative height anomalies, while the western precipitation was associated with the amplified ridge over the Rocky Mountains. It was the wettest July of record at Ely, Nev., with 1.81 in., and the second wettest at Pocatello, Idaho, with 1.25 in. Most accumulations over and west of the Rockies were less than 1 in. The largest monthly totals were in Florida where more than 10 in. fell at a number of stations. Tropical storm Becky brought much of this precipitation; about half the total of 16.13 in. at Tallahassee was produced by the storm. Farther west in Florida, Pensacola reported its driest July of record with 1.69 in., a deficit from the normal of 6.33 in.

A large area from the lower Rio Grande Valley to southern Illinois received less than half the normal rainfall, mostly less than 1 in. Several stations in Texas recorded only a trace. This region includes an area of extreme drought in Oklahoma and Texas that expanded considerably during July.

5. WEATHER BY WEEKS

JUNE 29–JULY 5

After a period of rapid change early this week, the circulation evolved into the pattern of eastern trough and western ridge that persisted through mid-July (figs. 6, 7, and 8). The week began with a sharp trough in the Western States accompanied by a vigorous storm that left up to 2 in. of snow in the northern Rockies on June 30. As the storm moved into Canada, the upper level trough first weakened, then redeveloped in the East ahead of the ridge that replaced it. Temperatures averaged below normal over the Great Basin and the northern Rockies as fresh Pacific air swept inland behind the storm. This airmass warmed quickly in the Northwestern States where maxima that had ranged between 60° and 80° rose to 100°F in

Washington. By contrast, maxima in the Northeastern States were reduced from more than 90° to the 60s and 70s. In Central and Southeastern States, temperatures that had risen to more than 100°F late in the week dropped sharply over the weekend. Precipitation was spotty with scattered amounts of more than 2 in. mostly in Southeastern States and the Appalachians.

JULY 6–12

Circulation and weather were much less variable this week under the regime that had just become established. One significant change was a migrating ridge that replaced the previous trough in the Gulf of Alaska. As ridge conditions continued over the Western States, temperatures rose there; but the trough immediately downstream resulted in a large area of below-normal temperatures in the East. It was wetter in the Southeast with locally heavy showers of 4 in. or more. Washington, D.C., had 4.69 in. during the afternoon and evening of the 9th. Rain was reported on 4 consecutive days in Ohio and parts of adjacent States associated with the slowly moving eastern trough.

JULY 13–19

Early this week, a vigorous trough crossed the Northern States followed by a strengthening ridge in western Canada. The circulation became more cyclonic in the Gulf of Alaska but less so in the Eastern States as the trough there became absorbed into the higher latitude wave train (fig. 8). A rather active Pacific front with the earlier trough brought showers followed by a substantial Pacific High and cooler weather over much of the northern half of the country. A stronger High of Canadian origin associated with the buildup of the western ridge began to move into the northern plains the last day of the week. Airmass showers continued in the South from Arizona to North Carolina.

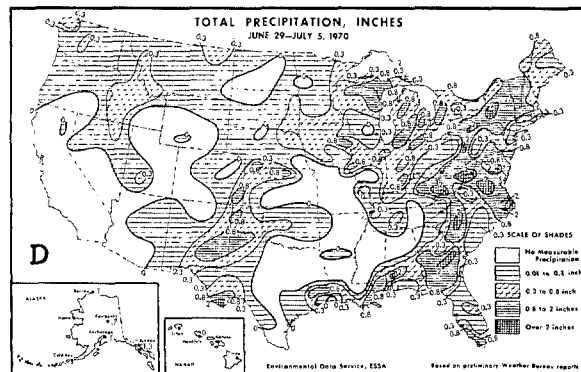
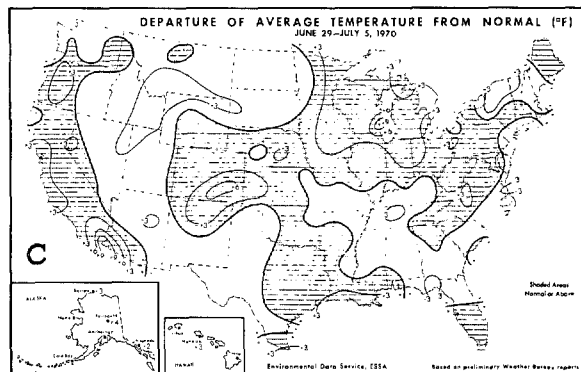
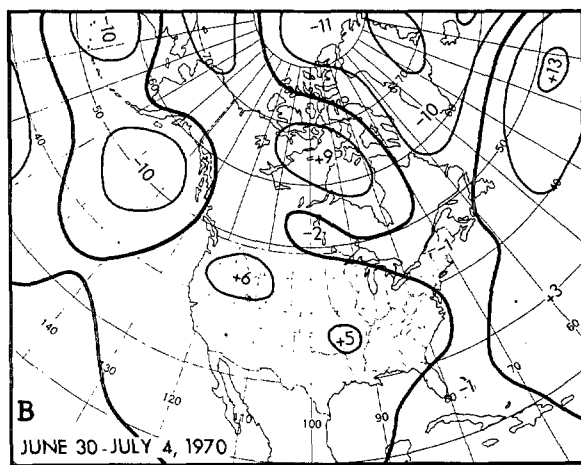
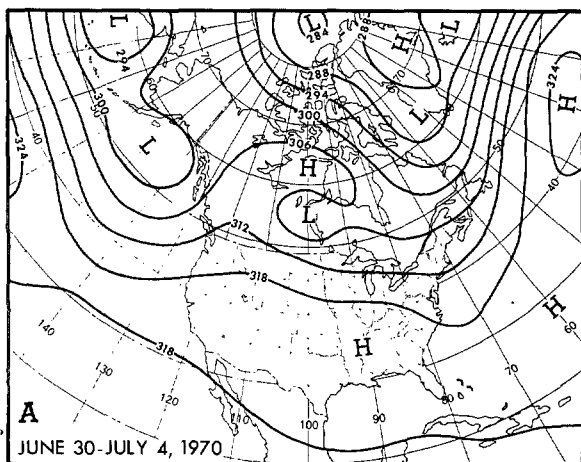


FIGURE 6.—(A) mean 700-mb contours and (B) departure from normal (both in decameters) for June 30-July 4, 1970; (C) departure from normal of average surface temperature (°F) and (D) total precipitation (inches) for week of June 29-July 5, 1970 (from Environmental Data Service 1970).

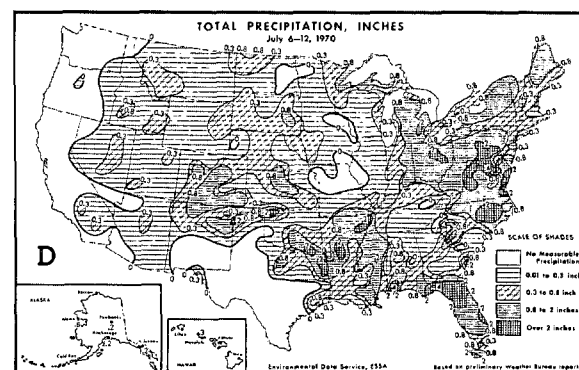
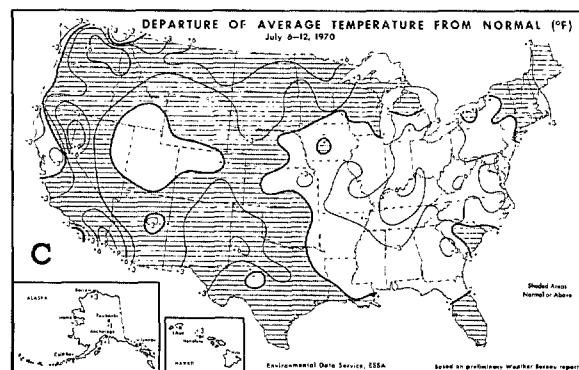
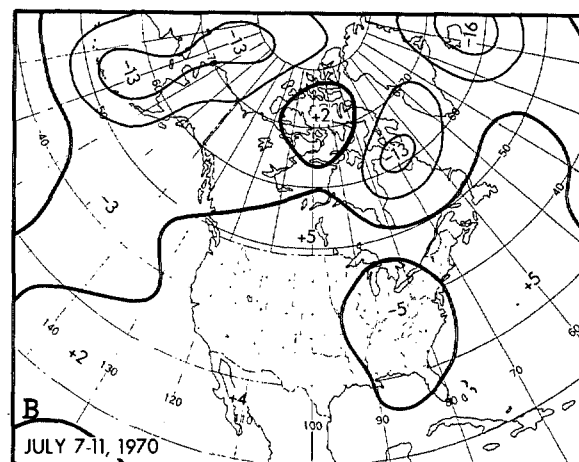
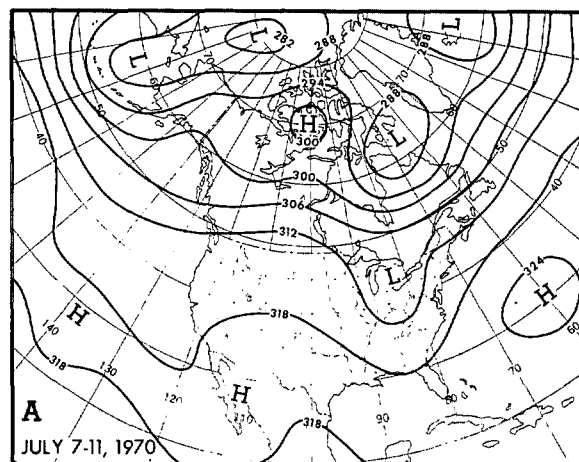


FIGURE 7.—Same as figure 6, (A) and (B) for July 7-11, 1970; (C) and (D) for July 6-12, 1970 (from Environmental Data Service 1970).

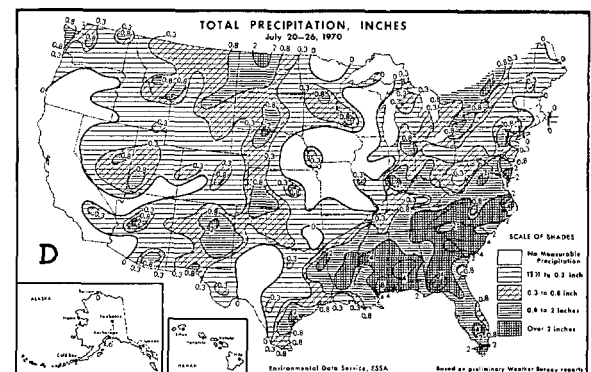
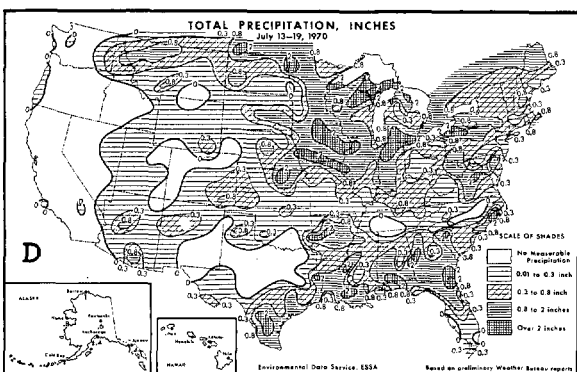
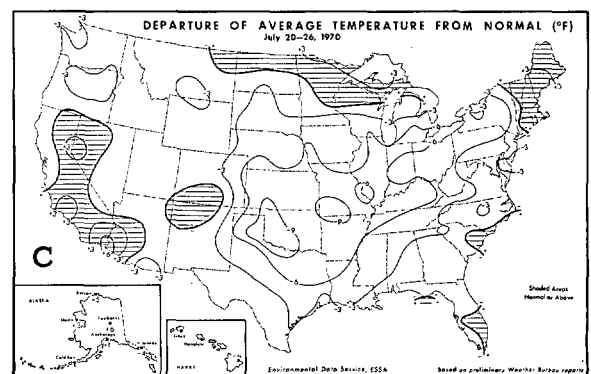
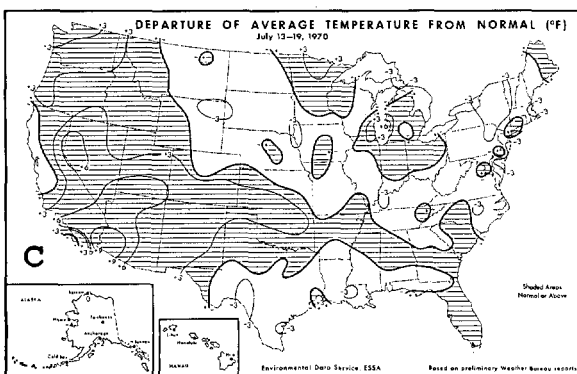
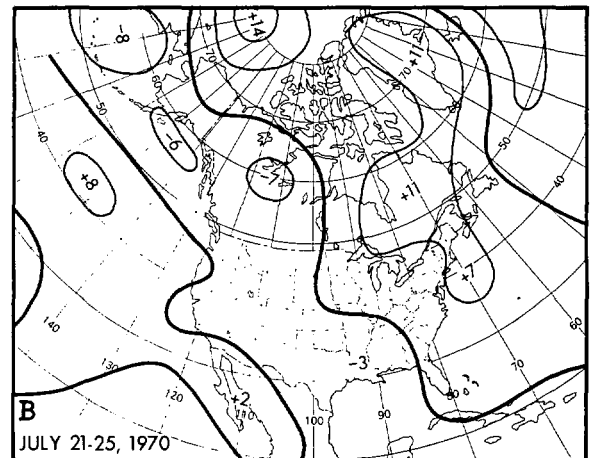
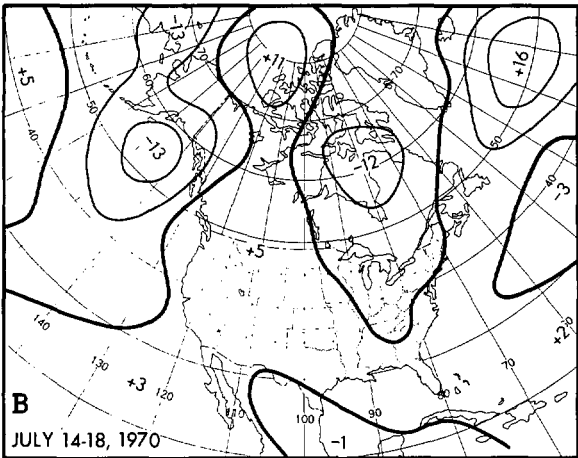
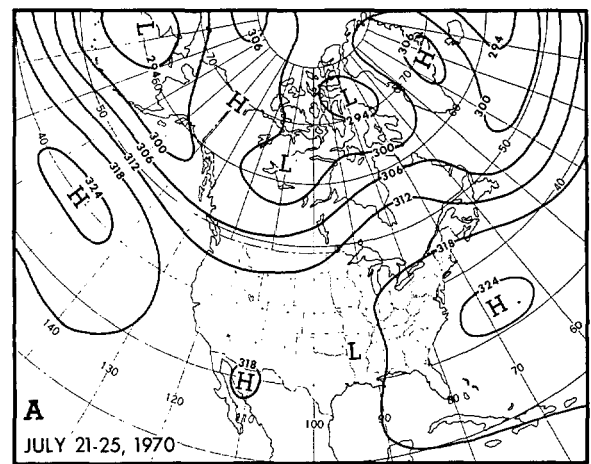
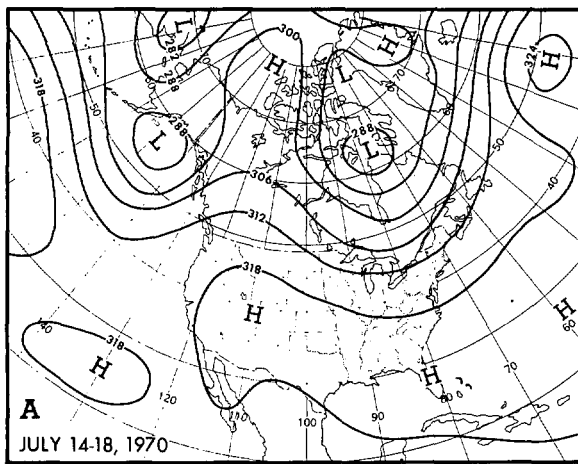


FIGURE 8.—Same as figure 6, (A) and (B) for July 14-18, 1970; (C) and (D) for July 13-19, 1970 (from Environmental Data Service 1970).

FIGURE 9.—Same as figure 6, (A) and (B) for July 21-25, 1970; (C) and (D) for July 20-26, 1970 (from Environmental Data Service 1970).

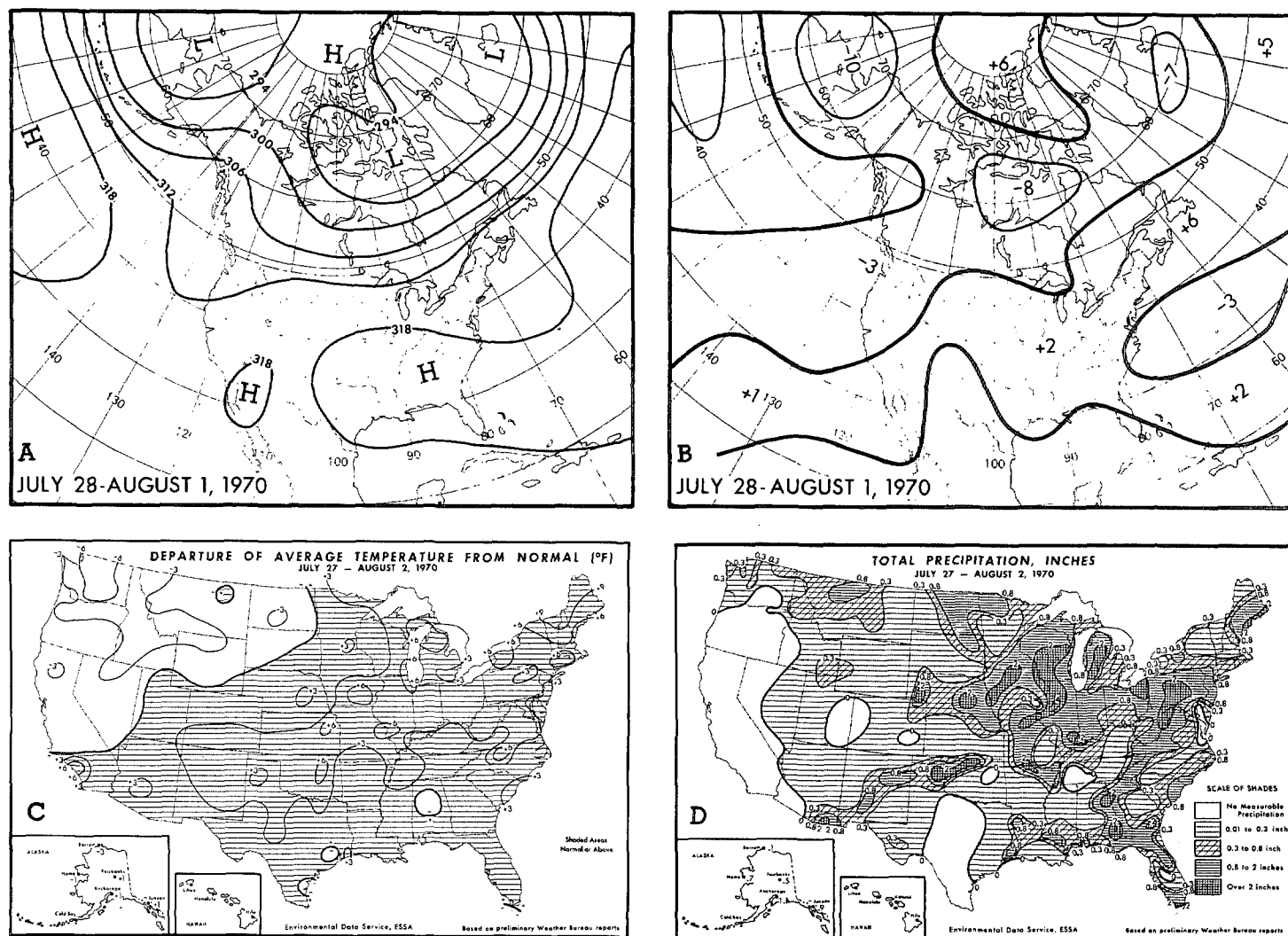


FIGURE 10.—Same as figure 6, (A) and (B) for July 28–Aug. 1, 1970; (C) and (D) for July 27–Aug. 2, 1970 (from Environmental Data Service 1970).

JULY 20–26

Reversal of the persistent circulation pattern occurred shortly after midmonth as the western ridge gave way to a trough and the eastern trough to a ridge (figs. 8 and 9). Negative height anomalies prevailed over the Western States for the first time this month, and departures were positive in the anticyclonic region over the East. Weather this week had several interesting features. Temperatures averaged below normal over most of the country (fig. 9C), influenced by the western trough, the strong Canadian High, and tropical storm Becky that drifted northward from the coast of northwestern Florida into Indiana. Early in the week, numerous record daily minima were established from the central Great Plains to western New York, caused by the cold High which thereafter began to warm. Tropical storm Becky weakened as it moved inland and did not penetrate far into the anticyclone. Moisture injected into the atmosphere from Becky accounted for widespread heavy rainfall over the Southeast (fig. 9D).

JULY 27–AUGUST 2

During this week, the circulation east of the divide was

generally anticyclonic as the Atlantic High retrograded into the Southeast (fig. 10). The sea-level High slowly weakened and drifted southward along the Appalachians. Under these stagnant conditions, urban and industrial contaminants accumulated in the lower atmosphere to an alarming degree for several days. The upper ridge weakened, and winds increased enough to eliminate the stagnant conditions by the end of the week. Additional ventilation was provided by increasing shower and thunderstorm activity over the northeast and central Appalachians. Temperatures were much higher east of the divide, especially in the region of southerly flow west of the surface High (fig. 10C). After an average of 8°F below normal at Tulsa, Okla., the previous week, temperatures averaged 6°F above normal. Similar increases of 12°F were observed at Oklahoma City, Okla., and St. Louis, Mo. Scattered showers occurred almost everywhere east of the Rocky Mountains. Rainfall in the Southeast was much lighter in the absence of tropical activity.

REFERENCE

Environmental Data Service, ESSA, *Weekly Weather and Crop Bulletin*, Vol. 57, Nos. 27–32, July 6, 13, 20, 27, and Aug. 3 and 10 1970.